

# *Climate Change and California Water Resources*

## **Alf W. Brandt Committee on Water, Parks & Wildlife California State Assembly**

My name is Alf W. Brandt and I serve as the California State Assembly's water law and policy expert. As principal consultant for the Committee on Water, Parks & Wildlife, I advise the Assembly on both water supply and flood protection issues. Before coming to the Assembly, I served in the Solicitor's Office for the United States Department of the Interior and as chair of the City of Los Angeles delegation on the Board of Directors of the Metropolitan Water District of Southern California, this nation's largest water supply agency.

With that background, I appear before you today to share some perspective on how California has and will respond to climate change in the water resource context. I will provide information as to:

- 1) why climate change has become so critical to California's water resource system;
- 2) the tools that we use to assess how climate change will affect our water system;
- 3) our current and planned responses; and, finally,
- 4) how the Congress may contribute to California's efforts to address climate change in its water system

The Federal Government remains an integral part of California's water system. It holds more California water rights than anyone else. It oversees the Central Valley flood protection system. And, its regulatory agencies work closely with ours on water issues ranging from quality to our state's abundant fishery resources. Indeed, the Federal Government has been an important partner in addressing our most important water resource – the Sacramento-San Joaquin Delta.

While the Legislature was successful in passing last year's landmark climate change bill, AB 32 by Speaker Fabian Núñez and Assemblywoman Fran Pavley, we have just begun addressing how our water policy will change in light of climate change. Speaker Núñez spoke on climate change and water resources to this year's American Bar Association Water Law Conference. In recent years, academic experts from our universities have studied climate change and water resources. Our state agencies have completed preliminary studies of the connection between climate change and water resources.

In February, the Committee on Water, Parks & Wildlife held its first informational hearing on climate change and water resources, where we considered the growing body of evidence as to the changes that already have occurred. Our Committee chair, Assemblywoman Lois Wolk, has authored Assembly Bill 224, to incorporate climate change into all the existing water planning processes that we now have in California. I would encourage your staff to review our Committee web page related to climate change, which we will continue to update with new information resources and links on climate change and water resources. See, <http://www.assembly.ca.gov/acs/newcomframeset.asp?committee=26>.

# I. The Challenge

In the last century, California constructed one of the most sophisticated water systems in the world. Relying on historical hydrological records, California's water pioneers studied, designed, and created a complex water infrastructure to support a robust agricultural and urban economy, now ranking in the top five of the world. The Federal Government built the Central Valley Project, which was originally adopted by the State Legislature and now is the crown jewel of the Bureau of Reclamation system, and the Central Valley's two flood control projects, on the Sacramento and the San Joaquin Rivers. In addition, the Corps of Engineers has worked with local governments throughout the State to address flood control issues.

The nature of California's water system makes climate change a central challenge for our continued development. Climate change will both affect – and be affected by – the operation of our water system. Changes in hydrology and water use mean that existing water infrastructure, which was designed to address historic droughts and floods, may not meet our needs. At the same time, our movement of water over great distances and treatment requires vast amounts of energy and, therefore, contributes greenhouse gases to the atmosphere and the climate change cycle. California therefore cannot avoid addressing climate change in the water resource context.

## A. The System

California's water system relies substantially on snowpack – from the Sierras to the Rockies – to hold the greatest proportion of water supply, releasing the water in late spring and early summer for irrigation needs of agriculture and urban communities.<sup>1</sup> Assembly Speaker Fabian Núñez recently noted that the National Academy of Science forecasts that climate change will reduce California's snowpack by 29% by the end of this century – a sobering statistic. Other studies have projected even more severe loss of snowpack.

**Snowpack and Reservoirs.** Reduced snowpack will change the efficiency of our existing water system, particularly our reservoirs, which were designed to provide flood protection, fill as the snow melted, and then hold water temporarily for use later in the summer or the following year. Those reservoirs cannot hold the entire amount of water coming down from the Sierras at once, leading to larger releases of flood flows and less water supply storage. Moreover, less snowpack – and more rain – translates into larger flood events.

**Sacramento-San Joaquin Delta.** The heart – both figuratively and literally – of the California water system is the Delta, where two large rivers – the Sacramento and San Joaquin – converge and then flow out to San Francisco Bay. Not only is the Delta the richest estuary ecosystem on the west coast of North or South America, but it is the transfer point for vast amounts of water to the San Francisco Bay Area, Southern California and San Joaquin Valley agriculture. The Delta is a unique network of leveed islands, major rivers and small sloughs. Climate change may affect the Delta by sea level rise, increased flood flows and longer dry periods. Sea level rise will put greater pressure on – and may overtop – levees surrounding Delta islands, many of which already lie below sea level. Increased flood flows similarly put more hydraulic pressure against Delta levees. Reduced water flowing into the Delta can affect both

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<sup>1</sup> Agriculture remains the largest user of California developed water supply – in the range of ¾ of water use.

Delta water supply and quality, as greater proportions of the water flowing in comes from upstream discharges and downstream sea water pushing in from San Francisco Bay.

**Groundwater.** Our water supplies also depend substantially on groundwater, which also can be affected by and can affect climate change. Many groundwater aquifers, particularly in the Central Valley, rely on natural infiltration. Drier conditions mean less natural infiltration. As those relying on depleted aquifers then drill deeper for water, their water use requires more energy, leading to greater greenhouse gas emissions. It is not unusual for isolated groundwater pumps to rely on diesel engines.

**Flood Protection.** The flood system, particularly the federal-state flood projects in the Central Valley, will suffer perhaps the greatest challenge because of its design. California voters approved almost \$5 billion in bonds to pay for repair and improvements to the flood system, with the bulk going to the Central Valley. The Indians called the Central Valley “the Inland Sea” due to its regular, expansive flooding during several months of the year. The flood “control” system of narrow channels enclosed by earthen levees was designed to channel flood flows and scour out mining-era sediment. In the last century, the system has worked so well, that we are now scouring out the levees. After Governor Schwarzenegger declared a state of emergency due to 24 sites of critical levee erosion, the Corps and the California Department of Water Resources (DWR) discovered 71 new critical erosion sites last year alone, after two rather moderate flood events. Add to that, substantial new Central Valley development, including housing in some of the deepest floodplains, and you face overwhelming risk of substantial flood damage. With the flood system already under stress, climate change will challenge every part of our flood system.

**Energy System.** The complexity of the water conveyance systems also has impacts on California’s energy supplies. A recent California Energy Commission report estimated the energy use arising out of California’s water use at about 20% of California’s total energy use. This proportion reflects the energy costs of moving water hundreds of miles, including south over the Tehachapi mountains to Southern California, and treatment both before and after its use. California water use therefore is a significant contributor of greenhouse gases to the climate change dynamic. In short, water use both affects and is affected by climate change.

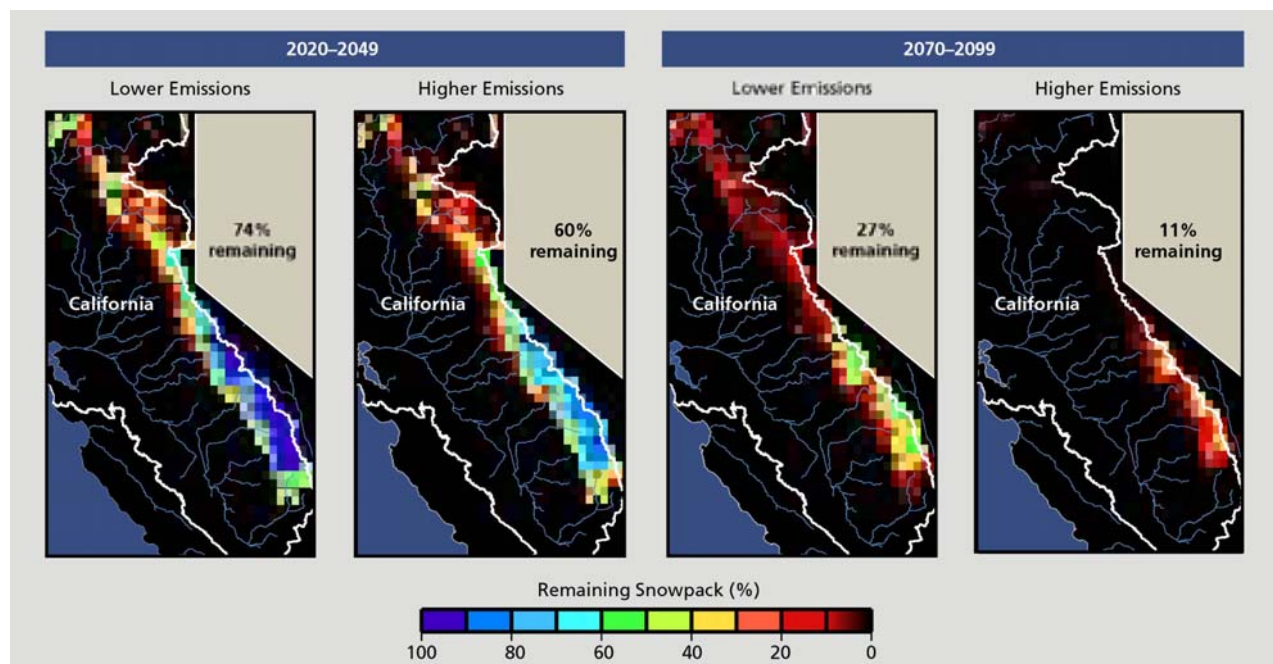
## **B. The Changes**

We now know that climate change is not just coming, it has arrived in California. We are fortunate to enjoy world-class academic and agency resources that can provide the Legislature, as policymakers, with the latest information on climate change, both current and projected. At recent hearings, we have learned the following facts:

- Sea level in the Delta has risen ½ foot in the last 100-years, advancing more quickly in the last few decades. Additional sea-level rise of this level or more will fundamentally change the Delta, threatening levees, land-use, water quality, ecosystem, and water conveyance capability.
- Floods have shown an upward trend, with floods getting worse as each decade passes, again, particularly in the last couple decades.
- California is warming, most dramatically in the last quarter century and over the winter months. We have reports of localized “heat bubbles” arising out of urban development, raising snow elevation 1500 feet since 1980, which means less snow pack and more rain.

- River flow is coming earlier in the year, reflecting less retention in snow pack. Late season (April-July) runoff has shown a downward trend over the last century.
- Scientists, using data from the Intergovernmental Panel on Climate Change, have forecasted that the Colorado River basin, on which Southern California relies, will be drier, similar to the droughts of the 1950's or this decade.
- The National Academy of Science has forecasted reduced Sierra snow pack of at least 29% by the end of the century, while other scientists have predicted a more severe drop.

These historic trends lead to projections of substantial climate change in the next 50 years. The most important projection of change for California's water system is the reduction in snowpack, our state's biggest water supply reservoir and winter flood reduction process. Reduction in snowpack means less storage for summer irrigation and larger winter floods, increasing hydrodynamic force on the weakened Central Valley levee system.



Climate change also means changes in California water-use patterns. Higher temperatures may mean less natural soil moisture, requiring greater reliance on irrigation. Higher temperatures also mean increased urban water demands for household irrigation, which comprises a significant portion of urban water use. Even current incremental changes in Southern California temperatures are reflected almost immediately in their water demands. This provides a good example of the interconnections between water supply and demand. As climate changes, these interconnections may appear more pronounced.

## C. Water Agency Responses

With the growing scientific consensus on climate change, water policymakers across California have begun assessing how best to respond. These efforts are not uniform, but are concentrated in the large urban water agencies in Southern California and the San Francisco Bay Area. Most agricultural water agencies have not started initiatives on climate change. Some have gathered anecdotal evidence of significant changes in the hydrology and a need to change operations, but some others reject any climate change projections. California's Department of Water Resources (DWR) has begun a concerted effort to integrate climate change into all its activities, both water planning and operations. California voters recently approved \$1 billion in funding for "integrated regional water management," and DWR has announced that its new guidelines for making regional funding grants will include requirements for assessment of climate change. For more specific information on water agency responses, see Appendix A.

## II. The Tools

In preparing for climate change, California enjoys a wide array of tools that will assist in preparing the water system to adjust to change, including:

- **Hydrologic Record & Modeling.** California enjoys more than a century of detailed hydrologic records. State and federal agencies also have worked closely to use that record to develop sophisticated modeling of the state's water system.
- **Climate Modeling.** Due to the substantial academic and federal/state agency resources that have focused on California's diverse climates, we have access to climate modeling that provides more precision than other states may enjoy.
- **Energy.** The California Energy Commission recently updated its 2005 study of the energy costs of water use, which may allow California to assess the energy costs – and greenhouse gas effects – of alternative water resource development plans.
- **Water Planning.** California has a long history of sophisticated water infrastructure planning efforts, in addition to the federal agency (Bureau of Reclamation and Army Corps of Engineers) planning processes. The State prepares a state water plan every five years and basin water quality plans are updated regularly. We also require local urban water suppliers to prepare an "urban water management plan" that looks out 20 years to assess the reliability of the supplier's water resources.
- **Land-Use Planning.** Since 2001, new housing developments with more than 500 units are required to show that they have an adequate water supply, based, in large part, on the water supplier's urban water management plan.
- **Delta Plans.** A large number of State and federal agencies have responsibility for managing the California Delta, which leads to large planning efforts on an almost continuous basis. Since the mid-1990's, Delta planning and management efforts have focused on the CALFED Bay-Delta Program. At this point, however, that program has collapsed and the State has initiated a process to develop a new, long-term "vision" for the Delta, including what changes will be necessary to sustain the Delta.

The diversity of tools has and will serve California well in preparing the water system for climate change. California's robust scientific resources may give our state an advantage in assessing, planning and implementing strategies for addressing climate change and California's continued population growth.

### III. New Approaches

Recent and projected climate changes demand a response. Climate change is not something that is far off in the future for California. We have experienced change already, requiring us to reassess our current water system and how improvements might provide the flexibility required to respond to uncertainties and unexpected changes. California continues to grow and urban water demand often increases with that growth. Climate change – both current and forecasted – adds a level of uncertainty that has led us to work toward preparing to respond to uncertainty and change.

#### A. California's Climate Change Response

California's water and flood policies are in transition, due in part to the threat of climate change. Events of this decade have led the State to re-examine its water policies, which were developed in the last century. Delta ecosystem collapse, declining water quality, a failed levee and Hurricane Katrina all led to California setting course to adopt a new long-term "vision" for the Delta for the next 50 years. A key part of the Delta vision process is how to address the changes over which we have little or no control – sea-level rise, invasive species and climate change upstream in the Sierras.

Hurricane Katrina and other local events, including a court decision placing liability for federal-state levee failures on the State, also have focused the attention of the Legislature and the voters on improving flood protection in the Central Valley, in light of changing climate. We are assessing the reliability of our levee system in light of climate change and new understanding. We are setting course for new strategies to protect our burgeoning urban centers in the Central Valley, with the largest and most-at-risk cities lying at the bottom of the river systems. The most important strategy is expanding the flood system's capacity, with setback levees, expanded flood bypasses away from urban centers, and use of natural floodplain diversions in case of larger than anticipated flood events. Even with \$5 billion in voter-approved bond funding for flood protection, California cannot afford to only repair and improve the "piles of dirt" that serve as levees protecting our Central Valley cities.

In responding to climate change, California is laying the foundation for a fundamental realignment of our water policies. We have begun this process, but have not finished it. Debate as to the best course of action continues. We can look ahead to further debate about how to respond to climate change, but the most important fact is that we are having that debate. We can no longer argue over whether the climate is changing. It already has changed. So, now the question is how to proceed in light of that change. We have laid the foundations for change with several efforts:

- **Assessment.** California has started with an assessment of its existing water infrastructure, particularly the levees protecting the Central Valley's urban communities. We also have begun examining how our water supply infrastructure may be operated differently to respond to climate change. Assembly Bill 224, by our Committee Chair, Assemblywoman Lois Wolk, would require State agencies to assess effects on climate change from alternative water supply development proposals, particularly recycling and conservation.
- **Planning.** AB 224 (Wolk) also takes a critical first step in incorporating climate change into California's water planning efforts. First, the bill would require the Department of Water Resources (commonly called DWR) to incorporate climate change into all its planning efforts, from the State Water Plan (Bulletin 160) to the developing State Plan of Flood

Control for the Central Valley. More importantly for California's diffuse water management system, DWR would build the foundation of climate change information by identifying peer-reviewed scientific information regarding climate change and California water resources. Then local water suppliers would incorporate, at least, that State-identified climate change information into their water planning efforts, including urban water management plans. Of course, those agencies with their own information may use information they deem reliable.

- **Infrastructure Choices.** Decisions regarding future water infrastructure development also need to include consideration of climate change information. Many California water agencies already have begun developing and incorporating climate change information into their development and operational decisions. As a state, we have begun discussing how climate change affects our water infrastructure decisions, but we have not concluded how best to incorporate such information and do not have broad agreement on the outcome of incorporating climate change into our decisions. (You may have heard about Governor Schwarzenegger advocating two particular dams/reservoirs based on a climate change theory.) But, based on the California Energy Commission (CEC) study, we have recognized that our choices on water infrastructure affects – and is affected by – climate change.
- **Promising Water Alternatives.** The CEC study also has suggested that some alternatives for expanding California water supply may help minimize greenhouse gas emissions, particularly recycling and conservation, which have some of the lowest energy-intensity ratings for water supply options. AB 224 supports these efforts by requiring our State Water Resources Control Board to study the greenhouse gas emissions arising out of these two alternative water supply options.
- **Flexibility in Floods.** In the flood protection context, California has begun assessing how best to prepare for larger flood flows, assuming that the current flood trends continue or worsen. DWR has focused its efforts on "managing for uncertainty" and developing ways to expand the flood system's capacity to accommodate more flood water. These expansions may be long-term or short-term, to respond to peak flood flows from sudden, unexpected flood events. These options may include identifying areas in the Central Valley to divert flood flows, so that the downstream cities of Stockton and Sacramento do not suffer the brunt of peak flows. Use of the floodplains in that way is consistent with nature's response to floods, allowing floods to spread out over the floodplain. Preparing for that floodplain use before the flood, however, will allow flood flows to be directed away from established development, thereby minimizing risks to life or property.
- **Floodplain Land Use.** California has begun the conversation about how to minimize risk of flood damages in light of climate change, particularly the increasingly larger flooding we have experienced in the last 25 years. After Hurricane Katrina, there was broader public recognition that levees cannot completely protect communities from flood risks. No matter how strong the levee, there remains residual flood risk. Then the question becomes how to minimize flood damages, and particularly risks to life, in Central Valley floodplains. The Legislature has considered bills to require greater flood protection for new development in floodplains where water is anticipated to be deeper than 3 feet if a levee fails. This year, our Committee Chair, Assemblywoman Lois Wolk, has authored legislation to engage local governments, which have responsibility for floodplain land-use decisions, in partnering with the state in implementing flood protection strategies.

## B. Federal Role & Recommendations

Federal agencies play an integral role in the management of California's water resources, so they necessarily have a role to play in helping address climate change in the water resource context. At this point, California has assumed a leadership role in addressing climate change. The Federal Government has three options for responding to that leadership: 1) support California's climate change efforts and work with our State water agencies; 2) do nothing and allow current federal law and policy to inhibit change; or 3) resist California's climate change efforts. I hope that we will see federal agencies adopt the first strategy and work closely with State agencies.

Congress may play a positive role in directing federal agencies to set a new course for addressing climate change in the water resource context, in cooperation with the State of California. In light of California's leadership on climate change and water resources, I would encourage the Congress to consider several options for enhancing our national capacity to respond, in the water resource context, to climate change:

- 1) **Require federal agencies to incorporate climate change into water planning.** Both the Bureau of Reclamation and the Army Corps of Engineers has a long history of completing water development or feasibility studies for water projects. Federal agencies also implement the National Environmental Policy Act (NEPA). Planning is integral to all that they do in water resources. These studies and planning initiatives should include climate change as an inherent part of any analysis or projection of the future. Incorporating climate change would require assessment of effects both on and from climate change.
- 2) **Adopt policies that address uncertainty in water and flood management.** Accepting uncertainty does not mean giving up on trying to protect Americans from flooding or providing water supplies. Rather, uncertainty calls for water system designs that allow for unanticipated change, such as the way California is pursuing long-term and temporary expansion of flood system capacity, to be prepared for the next big flood.
- 3) **Direct cooperation with leading states, including California.** California is fortunate to enjoy substantial academic and agency resources to study and prepare for climate change. California voters also have chosen to invest almost \$5 billion in better flood protection statewide. But, California's investment of scientific and financial resources in water resources does not allow the Federal Government to abdicate its responsibilities to protect the Californians from flood or drought. Instead, these investments call on the Federal Government to share in the financial and operational responsibility and follow the lead of the State of California in addressing climate change. The Army Corps of Engineers traditionally played the leading role in flood protection, but their funding in recent years prevents them from asserting leadership – or control – over the way that Californians choose to address water resource issues. Federal agencies need direction to cooperate with, not control, state decisions as to water resources and climate change.

- 4) **Recognize residual flood risk.** The Federal Emergency Management Agency's policies requiring only 100-year flood protection appear to ignore the residual flood risk arising out of 100-year flood protection, which means that homeowners have a 1-in-4 risk of suffering a flood over the life of their 30-year mortgage. At the very least, the Federal Government needs to do a better job of explaining residual flood risk to those who buy national flood insurance policies.
- 5) **Support states that minimize flood risks to life and property by effective floodplain land-use policies.** While the Federal Government is protected by federal flood immunity, its policies should nevertheless discourage development in the most dangerous floodplains, in order to minimize flood risks.

## **Appendix A**

### **California Water Agency Responses to Climate Change**

#### **California Department of Water Resources:**

- Issued the first major, quantitative report on climate change and California's water resources in July 2006
- Participates in the Governor's Climate Action Team; developed the greenhouse gas (GHG) emissions reductions goals for the California water management community in the CAT report
- Joined the Climate Action Registry and are evaluating the "carbon footprint" of the State Water Project and the rest of the Department
- Formally notified Nevada Power that we will not renew our Reid Gardner (coal) contract when it expires in 2013.
- Developing a renewable portfolio standard for the SWP.
- Exploring carbon sequestration opportunities in the Delta.
- Initiated the next update of the California Water Plan (Bulletin 160), the main theme of which will likely be the adaptation of California water management to climate change (including an in-depth analysis of the "water-energy nexus").
- Established a Climate Change Technical Advisory Group to help us better incorporate climate change into Bulletin 160.
- Includes climate change considerations in CEQA and other planning documents.
- Supports the Delta Vision Process, a main driver of which is climate change.
- Will require applicants to consider climate change/energy intensity/GHG emissions for Proposition 84 water-use efficiency and integrated regional water management grants.
- Initiated water system re-operation studies in response to climate change.

**San Francisco Public Utilities Commission (SFPUC)** organized and hosted a Water Utility Climate Change Summit early this year [Jan 31-Feb 1]. This watershed event brought together some 250 water and wastewater utility leaders from around the nation, agency officials and top climate researchers, and representatives from NGO's and the business community. Organized by and for water utility leaders, the Summit focused primarily on adaptation responses utilities are - and should be - thinking about in light of climate change. As a result of that Summit, a Steering Committee chaired by SFPUC General Manager Susan Leal and made up of managers of some of the largest utilities in the nation (including Metropolitan in Southern California, New York, Seattle, Las Vegas, Denver, Portland and San Diego) has begun meeting to learn from one another and speak with a collective voice about what we need from our federal, state, and regional agencies to help us grapple with these issues. Another important focus will tackle technical and scientific issues, where the group wants to raise the level of urgency for data collection and applied modeling efforts that will enhance our understanding of future precipitation and heat effects as they impact water supply, urban drainage, sea level rise, and other conditions. This information is urgently needed to inform water supply and capital improvement planning in the water and wastewater utility community.

**Metropolitan Water District of Southern California (Metropolitan):** Climate change has become an important consideration in the water planning efforts undertaken by the Metropolitan. For Metropolitan to respond to future uncertainties resulting from climate change, it has developed a diversified integrated resource plan (IRP) portfolio which includes investments in conservation and recycling, as well as maximizing storage and transfer programs to address “extreme” situations. In addition, Metropolitan actively attempts to identify and manage potentially harmful impacts of its facilities and operations – including energy-use reduction through capital improvements; employee programs, such as rideshare; and assessing the State Water Project-related energy cost-use relationship. Ignoring the potential causes and effects of climate change, and resisting the need to change, provides no solution to an inevitable problem that directly impacts Southern California’s water supply.

**Santa Clara Valley Water District (SCVWD)** has been looking at climate change and its effects on the water supply of Santa Clara County (Silicon Valley) for almost a decade. Currently, they are working on two levels of response. The first is mitigation – developing an inventory of their greenhouse gas emissions and focusing on reducing these emissions. SCVWD reports emissions to both Sustainable Silicon Valley and the Climate Action Registry. In addition, SCVWD was the first water agency in California to quantify the greenhouse gas emissions avoided as a result of their conservation savings. These avoided emissions come from all parts of the water supply chain and include reductions in energy usage for conveyance, treatment, distribution, end use (heating and cooling), and wastewater treatment. The amount of energy saved from their water conservation programs is greater than 5 times SCVWD’s total energy usage. SCVWD is actively working with cities, water retailers, and power companies to increase water conservation efforts to maximize the emissions reduction potential of these programs.

SCVWD is also adapting its business to account for climate change when planning flood protection and water supply projects. Climate change is a priority strategic challenge for SCVWD. The projected loss of Sierra snow pack threatens the reliability of their imported water supplies, the risk of severe and prolonged drought threatens the economy of Silicon Valley, as does the increased potential for flooding due to rising sea level and more intense storms. They are working with other water utilities and flood control agencies to understand the future reality of climate change and update projections based upon the best available science. Climate change is also being addressed in their watershed, flood control planning, and habitat conservation planning processes. Climate change analysis is also to be included as part of their environmental documentation for all their projects.

**East Bay Municipal Utility District (EBMUD)** is addressing both climate change effects on its water supply and its greenhouse gas (GHG) contributions to climate change.

- Approximately 99 percent of EBMUD's electrical energy production is from renewable sources, including small hydropower, methane production, and solar (photovoltaic systems). Currently, EBMUD generates 90 percent of the electricity needed to run its wastewater treatment plant from biogas that is recovered and combusted on-site.

- Our water conservation program is currently investigating the "embedded energy" in the treatment and distribution of both potable water and wastewater. EBMUD is working with the California Public Utilities Commission and the Pacific Gas and Electric Company to better quantify embedded energy.
- EBMUD was the first water agency to join the California Climate Action Registry, which records our efforts to measure and mitigate our greenhouse gas (GHG) emissions. EBMUD also actively supported the landmark bills AB 32 and AB 1493, which have established California as a global leader in addressing climate change.

**Inland Empire Utilities Agency (IEUA)** is a public water and wastewater utility that distributes imported water and recycled water as well as provides regional wastewater treatment services for six cities and two water agencies located in western San Bernardino County. The Agency serves 800,000 people within a 242-square mile service area.

IEUA is working to address the impacts of climate change through several initiatives. First, IEUA is developing local water supply projects in our Southern California service area including recycled water (100,000 acre-feet of new supplies), groundwater (150,000 acre-feet of dry year yield planned) and conservation to reduce our dependence on imported water supplies from northern California and, as a result, reduce greenhouse gas emissions. For example, the use of recycled water alone is expected to save approximately 3,000 kWh per acre-foot compared to the use of imported water, which is equivalent to 34 MW annually and would result in greenhouse gas reductions of about 100,000 tons of CO<sub>2</sub> equivalents per year (see attachment).

Second, IEUA is demonstrating the effectiveness of green building/low impact development by committing to maintain the highest standards in its facilities. Our new office headquarters, located in the city of Chino, is the first Platinum LEED-rated energy efficient facility to be constructed by a public agency in the nation. We expect our headquarters to become a zero-energy" facility by 2008, which will make IEUA the first public agency to achieve this goal in the country. The headquarters also demonstrates water efficient landscaping and storm water best management practices, and is used as a model by local cities to showcase use of permeable concrete and other water conservation strategies that reduce outdoor water usage (again, resulting in reduced imported water needs which will reduce future greenhouse gas reductions -- over 60% of residential water use within the Chino Basin is for outdoor landscaping). As part of this initiative, IEUA recently established the Inland Empire Landscaping Alliance which will develop recommendations for landscaping best management practices that will be incorporated into local ordinances and general plans.

Third, IEUA is building California's largest enclosed composting facility, which will provide significant air quality benefits as well as reduce greenhouse gas emissions. On the energy side, IEUA has developed an aggressive renewable energy program using energy efficiency as well as anaerobic digesters that convert organic material into methane gas that can be used as fuel rather than released to the atmosphere as a potent greenhouse gas. Currently we self-generate power, meeting over 30% of our own energy needs. Additionally, we have partnered with the dairy industry in the Chino Basin (the largest concentration of dairy cows in the world) to build the first centralized digester in the nation to use a combination of dairy manure and food waste. Using a monitoring protocol developed/peer-reviewed through the California Energy Commission, the project has documented emission reduction of almost 20,000 tons of CO<sub>2</sub> equivalents from the dairies over the past three years. IEUA has registered these greenhouse gas emission reductions and is the first entity in California to sell greenhouse gas credits that were

generated by "cow power" (see [www.ecoregistry.org](http://www.ecoregistry.org)).

Finally, IEUA participated in a study led by the RAND Corporation to evaluate the potential impact of climate change on future water supplies and to identify resilient water development strategies that will finish by the end of summer. This information will be incorporated into local water supply plans including the Santa Ana Watershed Integrated Water Management Plan which is now being updated.

**Merced Irrigation District (MID)**, located in Central California with water rights on the lower Merced River, is concerned about recent observed trends in snow pack conditions in its Sierra watershed, contained mostly in Yosemite National Park. With over a century of water records and decades of Merced River management experience vested in its water managers, MID has noticed a curious phenomenon: the snow pack seems to be melting earlier. That means the period of highest inflow occurs earlier – creating earlier peak reservoir inflow. This peak period appears to be averaging a couple of weeks earlier and it appears to be moving further into the spring.

MID operates the only reservoirs on the Merced River. Because of the National Park and the Wild and Scenic River designation for the river, no other reservoirs were ever developed in the Merced River. That means that MID has no upstream storage to help impound flood flows. During the 1997 "pineapple express" flooding event in California, MID experienced maximum inflow to the reservoir in excess of 100,000 cubic feet per second (cfs) with a rated downstream capacity of 6-8000 cfs. That experience, the lack of upstream storage and the hydrology data has led MID to the conclusion that its operating criteria must change.

In that regard MID contacted the Army Corps of Engineers (ACE) to discuss potential modifications to its "Rule Curve". MID sought rule changes to allow earlier storage of water when a light snow pack is detected. Tools now available for water supply planning such as snow water sensors in the watershed that relay real time data via satellite, snow pack radar scans, and manual confirmation studies performed throughout the winter are very helpful tools in managing reservoirs for water supply, but they are not used in flood control. Rule curves dictate exact formulas for operation without reference to local reality often resulting in wasted water.

ACE has just finished an analysis of the problem and will propose Rule Curve changes for most of the San Joaquin system. In the meantime MID is developing a groundwater storage system in the district in anticipation of using groundwater storage to offset potential surface storage loss. It is also studying the potential for raising the spill gates (not the dam) to provide more protection and potential storage. MID has an ongoing temperature study examining the potential effects of early snowmelt on water temperatures and hence on fisheries, particularly salmon.

MID also has invested over \$10,000,000 of grower money in conservation projects to better utilize the water available. The district has mechanized its diversions which are now centrally controlled by a computer driver control room. Regulating reservoirs inside the district avoid the loss of already diverted water. Agreements with local cities to use recycled water have been negotiated, and a district grant program for water conservation or conjunctive use projects established.

Many of these efforts have been undertaken for multiple reasons. However, the loss of water arising from the loss of surface storage is the economic incentive for them all.